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EDITORIAL

In the "learning shops" where "Colonel" Rotari of Boomington was outfitted, geography was not much more than a "bound Montana—locate Phoenix" type of memory exercise, and geology was unknown. The employees of the district school board had not been exposed to the writings of biologists, psychologists, and sociologists. Everybody in the neighborhood had some heredity, but nobody had yet acquired an "environment." Consequently the "Colonel" grew up to believe that every American-born child had the same opportunity, and to regard material prosperity as the prize which the gods impartially bestowed upon the winners in the great American free-for-all. Possessing such a faith, he could travel through any part of the United States, or the world, and tell from casual observation just what kind of people lived in every community visited.

Culturally, at least, we are all some kin of the "Colonel". Readily admitting our national or racial superiority, we can satisfactorily account for it by considering who we are. The scientific point of view grows slowly even in an age of science. To draw conclusions before the facts are all in doesn't trouble most of us—if the conclusions are favorable, if they are what we wish to believe.

The facts regarding that section of our country known as the Southern Mountains are not all in (even with the publication of this issue of *Mountain Life and Work!*). But a few more of them are set forth. For example, the "Colonel" himself could get a different view of the mountaineers through the eyes of Dr. Huntington ("A Geographer's Idea of Mountaineers"). Or State Geologist Jillson's statement in his article on "Geology of Eastern Kentucky Soils"—"an analysis of the area indicates that even with the best (agricultural) methods little permanent improvement can be expected"—is a fact to be considered by all who would understand the present or plan for the future of the area referred to. One may even have to change his ideas about those early Americans, the "Indians," after reading Dr. Funkhouser's "Ancient Men of the Mountains." And the data set forth in "Mineral Resources of the Kentucky Mountains," by Professor Burroughs, makes one feel sure that the future of certain

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A GEOGRAPHER'S IDEA OF MOUNTAINEERS

By DR. ELLSWORTH HUNTINGTON
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The geographer is sure that the people in mountains differ from those in plains. He wishes he were sure how much of the difference is due directly to the mountains and how much to the inherited character of the people. He also wishes he knew whether the mountaineers or plainsmen will win in the long run. In the southern Appalachian Highland it is easy to see the direct effect of the mountains. Travel there a little in a Ford car that prances on its "hind legs," thumps over stones, splashes through the creek every few minutes, and then gets stuck in the mud. Remember that your driver has picked the one good road in the region, and that only a part of the others can be traversed by wagons, for some are only trails. Then you will realize that poor transportation is an extremely obvious and direct effect of the mountains, and that it makes the people very isolated. But do not make the mistake of supposing that the mountaineers live far apart. They are no more scattered than are the farmers of the Blue Grass region, and much less so than those of Iowa. Nevertheless it takes much more time and effort for them to get together. If you live two miles from the center of a city, you can get to dozens of stores in five or ten minutes either on foot, by trolley, or by motor car. If you live two miles from the only store within a radius of five miles in the mountains and the creek happens to be up, you can get there only by a hard two hours scramble through the woods on a rough trail. It may be weeks before you can bring home anything except what you or your horse can carry on your backs over the trail.

But why put up with such roads? Does not their continued existence indicate incompetence among the mountaineers? Before you decide about that, examine a few mountain farms. Here is an unusually good one with five acres of level, well-cultivated bottom land in corn and three in hay. Yonder, a quarter of a mile away, two separate two-acre patches lie on the lower slope of the west side of the valley. A hard climb of fifteen minutes, which the farm boys do in half that time, will bring you to another three acres. Then you must go down again and up the east side of the valley in order to find the remaining two acres. They are the very steep kind where the boys say the gravel falls into their necks and trickles down their pant legs when they hoe the corn. The total cultivated area, including hay, is seventeen acres for a family of seven. Of course there are fifteen or twenty acres of rough, bushy pasture, and eighty or more of woods, but both are very poor. Compare such a farm with a hundred and twenty acres of rich crops and forty acres of fine hay and forage on a farm in Iowa.

But why does not the mountaineer clear more land and put his pastures into good hay the way the Iowa farmer does? Does not his way of farming prove his inefficiency just as much as do the roads? Try it yourself and see. If you could clear the trees and stumps from a piece of virgin forest on the slope of the mountains, and could immediately build terraces after the Chinese fashion, the fields on your steep slopes would be as fertile as those of the valley bottom. But think of the labor required to make the terraces, and remember that the fields on the top of your terraces would be so small that you could scarcely use a horse on them, while a tractor would topple over the bank in five minutes. Most of the labor would have to be done by hand.

But why not cultivate the slopes without any terraces? Millions of farmers have tried that, and the results are always the same. You cannot conquer gravity. The best soil is the finest; it lies on top where the leaves and roots

of plants have decayed and made it rich. Plow such soil and cultivate it, and see what happens when the rain descends. Unless you have taken extraordinary pains to plow according to the contour method and get the furrows exactly horizontal, you will find little rills of water running down the field. Those rills are *muddy*. Well, what of that? Why get excited about a little mud? The mud is the best part of the soil, the fine part on top that contains the greatest supply of plant food. Let the rains fall and the rills run for a few years, and tons of that wonderful mud will have been washed from each acre of land. That is what has happened to thousands of acres of poor pasture, scrubby bushes, and sorry-looking corn fields all through the hill country. Their fertility has been washed away by the rain. That might indeed have been prevented, but only at an enormous expense in human labor. Much of the land that the mountaineers still cultivate yields small crops because so many muddy rills have flowed from it; some that they cultivated down in the valleys has been injured by sand and gravel washed over it when heavy rains and melting snows have sent the creek on a rampage.

Here then is the situation of the farmer on rough land no matter whether he lives in New England, Tennessee, or China. First, even if he owns a farm of many acres, his fields are almost invariably small and scattered, so that he wastes time and effort in taking himself and his tools from one to another. Even if he works all the time he cannot cultivate so much land as can the man whose farm is level. Second because of the small size of the fields and because many of them are on slopes, the mountain farmer can rarely use complicated or expensive machinery, and cannot even use animals very effectively. That cuts down his production still more. Third, the soil rapidly deteriorates on the slopes and on the level land that is flooded with sand and gravel, so that no amount of work will give such large crops as could be produced on level ground that is never subject to harmful flooding. Fourth, when once the crops are harvested the work of getting them into the barn is great because of the distances and slopes, and the work of getting them to an outside market is still greater because of the bad roads. That cuts down the time that the farmer can give to productive work still more. The net result is that exactly the same man, with exactly the same energy and intelligence, may not be able to raise a quarter or even a tenth as much on a mountain farm as one in Iowa. The Chinese farmers meet this situation by maintaining an extremely low standard of living. The New England farmers have met it by abandoning their farms and going west or to the cities. Those of the Appalachian Highland have pursued an intermediate course between that of the Chinese and the New Englanders.

Now follow out the consequences of the small productivity which the mountains impose upon the farmer. One of the first is the poor roads. Good roads are extremely expensive. In many a highland region it would cost several thousand dollars per farmer to build the bridges, grades, and roadbed that would be needed to put each farmer on a reasonably good road. But where are mountain farmers to find the surplus for any such expenditure? The cost of roads increases faster than the income of the farmers, so that the hope that the mountain farmers unaided can build roads for themselves grows less and less. Similar conditions prevail in respect to machinery. It takes two or three times as many bushels of corn to buy a mowing machine now as it did a generation or two ago. But the farmer's land does not increase in size or productivity. So how can he buy machinery? And the machinery keeps growing larger, heavier and less adapted to small fields and steep slopes. Thus the situation grows worse, for the mountain farmer must compete with farmers who can use the most up-to-date machinery on farms that are level and large.

The case of the schools is much the same. If the mountaineer and his children are to learn new ways of helping themselves, schools are essential; but schools, like roads and machinery, are luxuries of civilization which require a surplus over and above the bare necessities. They form an integral part of our American standard of living. If we lower

that standard they can be kept open only a few months and only the most inexpensive and incompetent teachers can be employed. That is one of the ways where the lowering of the standard is most evident in mountain communities.

This brings us to the human factor in the equation of the mountains. Are the mountaineers less competent biologically than are the people of more favored regions? One phase of this question is easily answered. We have just seen that the mountains can neither attract good teachers from outside nor offer inducements to good teachers who happen to grow up at home. The same is true of carpenters, masons, ministers, doctors, lawyers, and all other kinds of people who carry on special jobs that require unusual ability or training. Such people are another example of the luxuries of civilization. They have to be supported out of the surplus arising from the work of the farmer, miner, woodsman, and fisherman. If these primary producers cannot provide a surplus over and above the needs of their own families for food, clothing, and shelter, how can there be anything wherewith to support the people who are luxurious? So the mountaineers must perforce get along with a minimum in the way of the people with special talents. Outsiders of this kind are not attracted to the mountains, and those who grow up there go away if their urge toward the use of their talents is especially strong. If there is any truth whatever in the teaching of biologists as to the inheritance of intellect and temperament, this process cannot fail to lower the general average of the population from generation to generation.

The biological average depends on still another process of selection. A comparison, county with county, of the richest and poorest agricultural land in various states shows that the average immigrant who takes up a farm in the poor counties is more illiterate than the one who settles in the richer counties. This is natural, for the newcomers whose native ability or opportunities have enabled them to read and write are more likely to be able to buy or rent good farms than are those who lack education because of either innate inferiority or lack of opportunity. The essential point is that in ordinary migration as it now occurs there is a distinct selection on the basis of ability; the better land gets the better people. There is abundant evidence that such selection accompanies practically every migration, and that it occurred when the United States was being settled.

When the early settlers left the Atlantic seaboard, what conditions led some to press on to the rich lands like the Blue Grass region, while others stopped in the mountains? The man who was unusually well informed was especially likely to know that it was worth while to push on beyond the mountains. Those who were well-to-do and therefore well equipped were also more likely than their poorer neighbors to keep on till they found a really good place. Those who had slaves were subject to a similiar tendency, for only on broad acres of good land did it pay to keep slaves. Thus the intelligent and prosperous types of settlers were likely to migrate clear across the mountains. Rarely did they choose a place for settlement through sheer accident as one family is recorded to have done, and as many others probably did. That family stopped because its rickety old wagon broke down, and it was too much bother to mend it. So there they stayed in the mountains. Many others who knew little of the country beyond the mountains and who did not look far into the future saw some pretty mountain valley and said, "This looks good. Why not stay here and build our house?" Others who were especially fond of hunting or of solitude, or of life among the hills doubtless settled down in the same way before crossing far enough to find the rich land beyond the mountains. And so did some who merely became tired of traveling. They preferred to take what they could get without struggling on to the better land farther west.

The final result is that even though the mountaineers are racially identical with the people of the lowlands, they are temperamentally and perhaps intellectually different. The original selective process among the first settlers and the later selective process whereby those possessed of special talents have tended to

move away could scarcely lead to any other result. This does not mean that the ablest mountain folk are less able than the ablest lowland folk. It simply means that the percentages of people with one type of mind or another are different in the mountains and the lowlands.

Another vital phase of the problem must still be confronted. Will the present differences between mountains and lowlands continue? No conclusive answer is possible. We may be quite sure that such pronounced differences in geographic surroundings will continue to exert a strong selective effect so that there will be some differences, even though not the same ones as now. But whether the mountain people or those of the lowlands will supply more leaders in the future cannot so easily be told. One important consideration is health. The mountains may not have many physicians and hospitals, and the sanitary conditions may be bad, but these very conditions tend toward increased constitutional vigor because they eliminate the weaklings. The difficulties of getting a living presumably tend in the same direction; the kind of people who become discouraged and hopeless are likely to die out. Moreover the mountain life is more healthful than that of the lowlands and towns. Few things could be better for growing boys and girls than the constant necessity to climb the slopes in search of the cows, walk several miles to school, and play among hills, brooks, and trees. How great the value of all this may be no one can tell as yet, but the combined value of the elimination of the weak and the healthful exercise of the fit must be considerable.

With this goes another fact which may be of vital importance. We know that the mountain families average larger than those of the lowlands and cities. We are confident that in spite of higher mortality the number who survive to become adults and parents is much greater per family than in the other environments. We likewise suspect that the falling off in the size of families among the better type of mountain people is nothing so great as among the corresponding type in the lowlands and cities. Thus the poverty, isolation, and backwardness of the mountains may mean that they are being saved from the devastation which is occurring elsewhere through the extraordinarily rapid decline in the size of the families of the more competent sections of the population. Moreover, it may be that intelligence counts for more in preserving life among the mountaineers where there are few external aids than in the centers of population where the poor and weak are helped to the limit, while the competent are left to shift as best they may.

Here then is the gist of the geographer's conclusions: The mountain environment means poverty, hardship, and isolation for those who cultivate the soil; it has led to a selective process such that certain able types of people with special talents are not well represented among the mountaineers; it has likewise presumably established a high degree of constitutional vigor among mountaineers, and is probably helping to prevent the best stocks from being eliminated as rapidly as is the case elsewhere. What all this will lead to we cannot say, but it raises the question whether in the end mountaineers may not supply more leaders than will a corresponding number of people from the lowlands.

"Mere getting is not important, whether that getting be of facts, grades, degrees, reputation, money, or power. Growth is the reason for being."—*Olive D. Campbell in "The Danish Folk School."*

"A meeting place away from the pressure of the necessary and commonplace, where youth, stirred by an inner impulse, could assemble and catch a glimpse of what life may mean—such was the school Grundtvig had in mind for the people."—*Olive D. Campbell in "The Danish Folk School."*

"The first and most important office of a school for the people must be to arouse desire —desire for a truer and deeper understanding of life, a purer and more vital personal expression in the service of a better nation and a better humanity."—*Olive D. Campbell in "The Danish Folk School."*

ANCIENT MEN OF THE MOUNTAINS

By W. D. FUNKHOUSER
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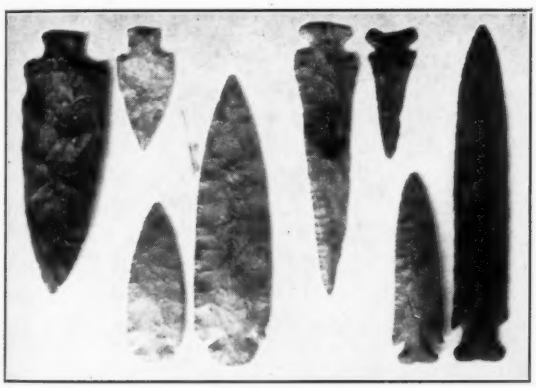
Long before the first white man came to Kentucky, hundreds of years before Daniel Boone left his family and peaceable habitation on the Yadkin River in North Carolina to wander through the wilderness of America in quest of that "countrie called Kentucke," before ever Gabriel Arthur, the young Virginian, pressed the first recorded white foot on Kentucky soil as an Indian captive, there were trails over the Kentucky mountains, paths along the tops of the ridges and well-worn winding passages through the laurel and rhododendron on the hillsides. These trails were used by the American Indians who had for generations considered this part of the Mississippi Valley a favorite hunting-ground. Many tribes were familiar with that part of the general highland region which is now Kentucky. The Shawnees tracked the bear and deer through the hollows, trailed the panther in the deep shadows of the forest and followed the buffalo over the flats; the Cherokees snared the wild turkey and the grouse in the thickets and stalked the elk in its runway; the Seminole occasionally came north from his favorite fishing-grounds to match his skill against the finny occupants of the rivers of Kentucky or to outwit the beaver in his almost human architectural pursuits. And regularly Shawnee, Cherokee, and Seminole fled before the grim invading Iroquois from the north who were the fierce, efficient conquerors of those days and before whom none could stand. The evidence of these occupations, these hunting trips, these fishing expeditions, and these war raids may be found all over our mountains in the form of the flints, the arrows, the implements, and the tomahawks, each telling its own story of its owner and often associated with a lone grave which in mute language testifies to the owner's fate. Apparently, however, no one tribe was allowed to claim Kentucky as its own—this region seems to have been a sort of "no man's land" in which all might hunt but of which none might take permanent possession.

But the American Indian was not the first inhabitant of the Kentucky mountains. He was a comparative newcomer who had reached this country and found it to his liking —rich in game, salubrious in climate, and free from the lodges of his enemies. Nevertheless, he found that others had been here before him —he saw strange mounds which he did not understand; he discovered curious piles of stones with which he was not familiar; he picked up interesting implements and weapons made of flint which were none of his; he noted ancient graves that he had not constructed. And when he was asked by the first white settlers as to who had erected these prehistoric monuments he replied: "I do not know; our people did not build them; they belong to a people whom our forefathers fought and drove from this territory, but whence these people came or whither they have gone, we cannot tell."

Who, then, were these ancient tribes who preceded the Indians and who left so many evidences of their occupancy of our mountains? Either they represented a very numerous people or else a small number who were here for a very long time, for they left their impression everywhere. In many localities in the mountains, the flint arrowheads, stone celts and axes, broken pottery and bones, may be found on the surface of the fields by the bushel. If all of these things were lost or discarded by their owners, it indicates either a large population or a long occupancy. Also, the Kentucky mountains are dotted with the so-called "Indian Mounds," "Indian Graves," "Indian Forts," and other evidences of human occupation of the country, which were not made by the Indians but by a prehistoric man.

These men were Neolithic in culture or at

most were just passing into the Cyprolithic stage: they used chipped and polished stone; they worked in bone, wood, and shell; they knew the use of fire; they had developed certain religious or ceremonial practices; they buried their dead. It is the last two of these customs which give the most valuable information to the archaeologist. Apparently even the most primitive of peoples have had a respect for the dead—probably (for the instinct still remains with the race) the primitive philosophy regarding a dead body was that it was a curious combination of something to be dreaded and something to be cherished. At least they made some attempt at protection and preservation, as illustrated by the various types of graves, tombs, cists, sepulchers, and mummifications found in all



Weapons of the Early Mountaineer

parts of the world. In Kentucky, Neolithic Man generally constructed some sort of grave. But it was no easy task for primitive man to perform even so simple a task when he had no tools for digging and the soil was hard or the ground frozen. Probably the best that he could do was to scratch out in the earth with a sharp stick or stone a slight depression, and in this, place the body. But religious or ceremonial rites would be observed—the head would be placed toward the rising or toward the setting sun, or the body must face the east or the west, or the corpse must be straight or flexed, or the hands must be in a certain position—in order that the deceased might make proper entrance into the spirit world. Then with the body would be placed the objects supposed to be needed on the long journey—food, weapons, emblems of his rank, perhaps gifts for the gods. All of these things tell us something about his race, his culture, his position in his tribe, and even in many cases, his occupation. It is evident, therefore, that the bones and the artifacts in graves furnish most valuable data for the archaeologist, and it is equally evident that these things must be studied with the greatest of care. Lastly, large stones were placed over the body to protect it from the wild beasts, and loose dirt was heaped over the whole, thus making a mound. Of course, after a battle or a massacre or a pestilence, many bodies might be buried together, thus making a mound of considerable

A Typical Mound Built by a Prehistoric Race

size. Also, later burials might be made in the same mound to save the labor of constructing a new one, and the same process repeated so that in the course of time the sepulchral tumulus would rise high above the surrounding country. Again, it might happen that long after the original builders of the mound had perished or moved away, other tribes might take advantage of the mound for similar purposes. Thus we get the "intrusive" burials which are so confusing in identifying a culture.

Archaeologists are now convinced that five or six very distinct groups of prehistoric peoples occupied Kentucky in by-gone ages and that at least three of these groups often

lived in the mountains. As to how long ago they were here we do not know; as to their chronological order we cannot tell; where they came from is still a matter of dispute; but as to what they looked like and how they lived we have considerable information, because of the skeletons which we find in their graves and the artifacts with which they were associated.

One of these groups we call the "mound-builders," not because this name has any scientific significance, for all mounds were not built by the same people, but simply to indicate those tribes who had the habit of constructing mounds for various purposes. Some of these mounds were used for burials and in them may be found the skeletons which give us a good idea of the appearance of the individual; often we find with the skeleton the weapons or the tools of the deceased which he was supposed to need on his trip to the "happy hunting grounds," and thus we secure information as to his culture. Other mounds were used for ceremonial purposes and in their construction we recognize the fire-baked clay and the charred bones which represent the sacrifices; sometimes a gruesome find in such a mound tells the grim story of the captive burned at the stake. On high elevation may be found mounds from the top of which a wonderful view of the surrounding country may be secured; these mounds are usually constructed simply of earth and stones with no indications of burials or religious rites, and we assume that they were observation mounds from which the signals from blanket-semiphores or fires were sent or from which a look-out was kept for enemies. Again, near village-sites, we find mounds which are merely great refuse-heaps, technically known as "kitchen-middens," and which represent the trash piles or the accumulation of rubbish; such mounds, containing as they do the broken pottery, the bones of the animals used for food, the discarded flints and the worn-out weapons, often furnish valuable information as to the habits, the food, the industry, and the village life of the tribe. The so-called "mound-builders" are generally believed to have been, not a distinct tribe or culture, but merely the ancestors of the more modern Indians, who lived so long ago that their history, traditions, practices, and habits have been lost in the mists of time and were not even remembered by the Indians themselves.

Another group of prehistoric people apparently did not live in the open and build mounds, but preferred to inhabit caves and bury their dead in the floor of the caves. This group may be called, for the want of a better name, the "cave-dwellers," again with the understanding that the term has no strict archaeological significance, but refers merely to the habits and habitats of the people. Kentucky is famous for its splendid caves, ranging in size from the gigantic caverns such as Mammoth, Crystal, Onyx, and others in the Edmonson County region to the smaller caves which are found almost everywhere in the state where the soluble limestone is at or near the surface. These caves have always been, and are now, the homes of many animals—foxes, rats, bats, coons, skunks, snakes, salamanders, various insects, and even the peculiar blind fish find them suitable habitations. That the caves were inhabited by men as well as by the lower animals there can be no doubt, and indeed primitive man could hardly have found a more satisfactory type of shelter. Ordinarily, as would be expected, the portion of the cave close to the mouth was most commonly occupied, and naturally those caves which were most roomy close to the entrance were the favorite dwelling places. Probably the deeper recesses of the caverns were sought only in severe weather. Caves which are of sufficient depth have about the same temperature the year round, offering protection from frost in the winter and affording relief from the heat in the summer. In such abodes the early tribes found protection both from the elements and from their enemies, for a cave is easily protected, offers plenty of room for the storage of food during a siege, and usually contains water. In these abodes, also, they buried their dead, perhaps because of religious beliefs or perhaps because the floor of the cave was never hard or frozen and was easy of excavation as compared with outside conditions. Whatever the reason, it is fortunate

for the archaeologist that this was the practice, for cave conditions are conducive to long preservation of human remains. The elements are kind to a cave burial—the rain, wind, sleet, and snow never disturb the underground grave; sudden changes in temperature do not occur to disintegrate soil or bones; the earth itself is often impregnated with salt-peter which seems to be an excellent preservative of organic matter; often the stalagmitic formations cover the skeletons and effectually protect them, and often the mouth of the cave falls in and prevents the intrusion of man or beast until, by some fortunate chance, the chamber is reopened. Some of the finest of the archaeological material ever discovered in the state has been found in caves. Of course, if the cave has a rock bottom there can be no burials, and if water constantly runs through the cavern there is little chance of finding evidences of prehistoric occupation, but any cave fairly high and dry and having a dirt floor is likely to yield archaeological treasures. That the cave-dwellers spent much of their time outside the cave, but near its mouth, is evidenced by the remains of campfires, the work-shops where flint artifacts were made, the kitchen-middens, and even the stone hoes on nearby level ground which prove that they cultivated the soil.

Just as some of the ancient inhabitants of the mountains were distinguished for the building of mounds, and others were partial to caves, still others seemed to prefer to live in high and sometimes almost inaccessible "rock-houses" or rock shelters far up on the precipitous sides of the cliffs. The Kentucky mountains abound in overhanging walls of rock which offer no mean shelter beneath their massive roofs. Such a site for a home has many advantages. Like the cave it is easily defended from invaders from below; it offers

Skeletons of mound-builders in characteristic positions Photo by W. S. Webb

splendid protection against wind and rain; it is safe from wild beasts; it affords a wide outlook over the surrounding country. The people who occupied these rock shelters and whom we may call the "cliff-dwellers" developed some interesting practices, which in some cases are quite distinct from those of other groups. One of the most characteristic of these practices was the excavation in the floor of the cliff of the so-called "hominy-hole" which seems to have been used for the grinding of corn. Near these holes may usually be found the stone pestle which was probably used in grinding the grain in these deep holes. The hominy holes are often three or four feet deep, generally four or five inches in diameter at the top and gradually becoming narrower toward the bottom. Most rock shelters show such holes and sometimes where there is a long line of shelters along the face of a cliff, each shelter will have several holes—some deep and discarded, some of average depth, and some in the process of excavation. Another peculiarity of the cliff-dwelling is that the kitchen-middens or trash-piles are not in the shelters but far below them at the foot of the cliff, doubtless due to the fact that the easiest way to clean house in such a situation is to sweep everything over the edge of the cliff. In such kitchen middens may be found sometimes articles which were not intended to be discarded but which were accidentally dropped off the floor of the shelter. The graves of the cliff-dwellers are usually against the back wall of the shelter. Here the dirt is never very deep and the burials are therefore very superficial. Nevertheless, excellent skeletons have been found in such localities. One of the most important discoveries made in Kentucky was that at the Pine Mountain Settlement School, where in 1923, Miss Frances Johnson, at that time a student at the school, found in a rock shelter nine prehistoric skeletons of great age and unusual archaeological interest. The mountain region of Kentucky is very rich in these rock-shelters, very few of which have been investigated. Wherever overhanging ledges occur along the canyon walls of streams, as for instance, where the middle Kentucky River has cut its gorge through the hard Highbridge limestone, such sites are common. In coves trenched in the Coal Measure conglomerate along the western border of the Coal Fields, they are abundant. In fact, in any of the counties which border the eastern coal fields there are sure to be found these early habitations of man. Also, most of these locations are in rough country which is thinly inhabited, and thus the sites have not as yet been disturbed by the vandalism of modern civilization. Thus there is offered a wonderful opportunity for first-hand investigation of one of the best sources of archaeological information in the United States.

Many rock shelters may be found along the old "Indian Trails" across the mountains. Since these trails are often winding and do not always follow the shortest or even the easiest routes, it is possible that they were purposely made to pass close to these shelters for the very evident advantage which they would offer for camping-places and protection. The overhanging rocks in these places are often deeply stained by the smoke from many fires and show plainly that they have been used many times, and in fact even today they not uncommonly serve the same purpose for modern hunters and trappers as they did in olden times for the cliff-dwellers. Often, too, these "rock-houses" are used by the present owners of the land as shelters for stock, for pens, for stables, for outbuildings, and for storehouses, since they are high, dry, and permanent. It is even rumored that they are not ill-suited for the location of moonshine stills. In such a shelter, which had been fenced in for a hog-pen, on the farm of Mr. Boyd Howard in Magoffin County, was discovered two ancient skeletons which were evidently the remains of an adult and a child who had been killed by a rock falling on them from the roof of the shelter.

Thus the Kentucky mountains offer opportunities for the student of anthropology and archaeology which are probably unsurpassed in any other section of the state. Unfortunately, however, much of this valuable material is being ruined by ignorant persons who destroy the ancient graves and the prehistoric sites without realizing their scientific value. Often a mound is torn to pieces, the bones scat-

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GEOLOGY OF EASTERN KENTUCKY SOILS

By DR. WILLARD ROUSE JILLSON *State Geologist of Kentucky*

Since the quality and characteristics of all soils are so clearly an inheritance passed on by the decomposed parent rocks, it is quite worth while, from an agricultural point of view, to give serious consideration to the general principles of geology, insofar, at least, as they have to do with the primary classification of the rocks and their habits of soil formation. In Kentucky a very interesting relationship exists. Here, perhaps as well as anywhere, it is possible to see a fine balancing of the various operative factors. The several natural regions of this state may be considered distinctive types. It is the purpose of this article to set forth some of these geologic relationships and thereby enable the student of agricultural conditions to realize a little more clearly the real causes for certain soil conditions which are now fairly well defined in Kentucky.

The famous Blue Grass region is particularly instructive in this connection. Long intervals of time are necessary for the formation of all thick residual soils. Such deposits do not represent entirely the disintegration of sedimentary or igneous beds upon which they are superposed as is commonly thought to be the case. Quite contrary to this they are generally an agglomeration of residual materials resultant from the decomposition of many beds of rock much higher in the geological section. In many cases little is left with which to reconstruct theoretically hundreds of feet of the eroded strata. Such is definitely the case in the Blue Grass region of Kentucky.

Sculptured into the surface of Kentucky like a nail-studded horseshoe open to the north, the "Knobs" belt surrounds the Blue Grass region and separates it from the Pennyroyal (Mississippian) plateau. Topographically, it is a rough area 10 to 20 miles in width and about 230 miles in extent. Its area is about 3,400 square miles. The Knobs region is characterized by a great number of more or less isolated conical hills resting upon the Tertic, or Lexington, plain. The region exhibits a relief ranging from 400 to 700 feet. The hills generally are too steep to be of much agricultural value. Their soil covering is the Dekalb yellow-gray, generally somewhat stony, shale-loam, which is without exception the poorest in this belt. Most of the knobs are therefore timbered in small second or third growth pine, gum, oak, and chestnut. When flat-topped they are usually capped by a relatively thin bed of Pottsville conglomerate sandstone, or Chester limestone. Elsewhere they are entirely conical to the peaks.

Stratigraphically, the rocks of the Knobs are of Siluric, Devonic, Mississippian, and occasionally Pennsylvanian ages. The complete section measures about 800 or 900 feet. It consists of shaley limestones, dolomitic limestones and thick-bedded shales from the first Siluric beds up through the Devonic and lower Mississippian sections. Superposed upon these are considerable thicknesses of even, cross-bedded, fine-grained, siliceous beds (Logan-Warsaw formations) which are covered by massive cherty and oolitic limestones. The hills, well-exemplified by Mt. Minerva at Irvine, are thus actually outliers of the Mississippian plateau presenting a steep face towards the Blue Grass tract or lowland.

This great escarpment, known from the earliest times as "Muldrows Hill," so cuesta-like in its figure, is one of the most striking topographical features of Kentucky. It has its origin in the resistant qualities of the Pottsville conglomerate and underlying Mississipian limestones and fine-grained sandstones, which capping the weaker shales and limestones of Devonic and Siluric ages protect them from complete erosion. Wherever the basal Mississipian beds break through by stream action, broad flat lands with deep, residual, heavy-clay

soils develop. This soil is known as the Dekalb silt loam. These areas are but slightly productive from an agricultural standpoint, due to the fact that they drain very poorly and are low in calcium carbonate, phosphates, and other important soil ingredients.

The Knobs region is one in which better methods of farming, including land-drainage and selection of crops, will do much to improve agricultural conditions. This is indicated in the notable results obtained on the experimental farm of Berea College, in Madison County. But it is not anticipated that this area can ever be made even by the practice of the most modern and diligent methods, to compete successfully with the more fertile Blue Grass area adjoining. The geological phenomenon of differential erosion is responsible for the hilly, "bad land" nature of the Knobs. Were it not for a humid climate and plentiful rainfall the physical aspect of the Knobs belt would be almost an exact duplication of the "Butte" country so typical of the high arid plains of the western United States.

Not more remotely than the Early Cretacic times the open circle of Ordovicic (Blue Grass) limestones within the Knobs belt was small. Through two complete cycles of peneplanation, and all of Cenozoic time, the ceaseless beveling by erosion has resulted in a very marked outward and down-dip migration of the Knobs belt, producing the extensive Blue Grass region as it is known today. And this process is actually, though of course very slowly, in operation at the present time. Theoretically it is no flight of fancy to forecast a time in the near geological future when the Knobs belt will have enlarged itself to such an extent as to increase the Blue Grass area 25 per cent to 50 per cent. Coincident with this expansion a large exposure of Ordovicic limestones will be developed, connecting the north-central part of Kentucky with the north-central portion of Tennessee through the upper Green and Cumberland River valleys.

The Eastern coal-field of Kentucky comprises an area of approximately 10,500 square miles. It covers all of this State east of the line passing more or less irregularly southwestward from South Portsmouth, in Greenup county, to Albany in Clinton county. The topography of this entire area is either rough or rugged. It begins with the steep, west-facing, sinuous escarpment extending along the outcrop as already described. Stretching southeastward it continues across a maize of timbered, knife-like ridges and narrow meandering valleys, to the Pine and Cumberland mountains—the State's border.

Physiographically the region is a maturely dissected, uplifted plain, known widely as the Cumberland Plateau. Summit elevations on the west outcrop range from 1000 to 1200 feet. Progressing eastward these rise to 1500 and 1800 feet in the Middle Big Sandy; while to the southeast these elevations increase to 2000 and 2200 feet, on ridge-tops immediately west of the Pine Mountain. Peak altitudes on this great range and its sister mountain, the Cumberland, vary from 2500 to 3500 feet, while summit elevations on the Big Black Mountain rising grandly between them are the highest in Kentucky—4150.

The Pine Mountain has its origin in a great faulted anticline, overthrust to the northwest two to five miles or more. The magnitude of this break is indicated by the fact that it extends continuously for over a hundred miles through which distance the Chattanooga shale is frequently brought to the surface along its northwest face. The Cumberland Mountain, roughly parrallel with the Pine Mountain, is a part of the raggedly eroded, upturned, western flank of the Powell Valley anticline of Tennessee and Virginia, which, if it could be reconstructed, would rise to majestic heights of 15,000 or 20,000 feet.

As important integers in structural features of so vast proportions, developed by great crustal movements during Appalachian Revolution at the close of the Paleozoic era, the Pine and Cumberland mountains assume individual significance. They are, in fact, the only mountains of true elevation in Kentucky.

The remainder of eastern Kentucky, though popularly described in song and story as "mountain country," does not in fact exhibit mountains at all. The region is simply one of steep, winding ridges resultant from long-

continued stream-erosion in the clastic rocks of a plateau which sharply tilted to the northwest. The local relief of the region, however, varies from 500 to 1500 feet, which coupled with steep, rock-faced and timbered slopes is sufficient to be impressive, and justifies in the minds of many, including inexperienced travelers from the Blue Grass country and elsewhere, the very descriptive physical term, "mountains."

Stratigraphically the rocks of the Eastern coal-field are divided into three sections: the Pottsville, the Allegheny, and the Conemaugh, all standard divisions in ascending order of the Pennsylvanian column. The greater portion of eastern Kentucky is surfaced by rocks, sandstones, sandy conglomerates, shales and coals, of the Pottsville. These rocks, as a matter of fact, are to be found at all subsurface points within the coal-field. On the western outcrop they consist of sandy conglomerates and shales ranging from about 60 to 300 feet in thickness. In this conglomerate country, exemplified by portions of Jackson, Rockcastle, Laurel, Pulaski and McCreary counties, the soils on the ridges are derived directly from the underlying coarse, clastic formations. As a rule these soils are thin, sandy and gravelly. They contain little clay and are therefore but slightly retentive of moisture during periods of drouth. The valley soils of this subdivision of the Eastern coal-field are all alluvial and though productive are so limited in extent as to be of very slight economic value. Taken as a whole this rich country is one in which unfavorable geological factors have combined to produce very poor agricultural conditions. And in addition *an analysis of the area indicates that even with the best methods employed little permanent improvement can be expected.*

It is readily apparent that in a region of such great relief, where clastic sediments form virtually the entire geological section, *agriculture should not be expected to attain more than a mediocum of success.* Such is, indeed, the case in eastern Kentucky. Residual soils, generally silt, or sandy, clay-loams, are thin and of low productivity. Hillsides facing east and north generally show a deeper soil and are therefore better fitted for tilled lands than those exposed to the west and south which exhibit a closer adaptation to grass and retimbering. Nearly all old hillside fields will be found, upon examination, to have washed badly. The mountain slopes are, in fact, generally too steep for cultivation. *That they are farmed, usually after an antiquated fashion, is a sad commentary on our established economic order,* for the total produce thus obtained will scarcely make adequate return for value of the farm labor expended. Newly cleared land, though steep, will produce a fair crop—generally corn—for the first three or four years, after which time it becomes leached and washed beyond restoration.

Though very commonly such hillsides are tilled for many years after clearing, their productivity is exceedingly low. Except in an over-populated, retarded region such as the mountains of Kentucky, such tracts would never be farmed. Reforestation is the only hope of these steep mountain slopes. Nothing else can keep such areas from degenerating into barren, gullied, hillside lands. Though effective and demonstratedly profitable over a term of years, woodlot and wornout hillside mountain farm reforestation has found but few followers in Kentucky. Nature, not man, appears to be the greatest friend of the old, gullied-mountain corn patch. Stepping in at the time of actual abandonment she blankets it with a small growth of green bushes and tree seedlings which, if protected from ranging herds of half starved cattle and sheep, will soon re-cover such slopes with an adequate stand of timber. In due time selected cuts from such naturally produced woodlands will outvalue any annual crop.

The residual, or "bottom," soils of the mountains are the best in this region. Along the main courses of the larger rivers, such as the Big Sandy, the Kentucky, and the Cumberland, the soils of the flood-plains are deep, well-watered, and fairly productive. Consisting generally of heavy, sandy clay-loams, they are usually deficient in calcium carbonate, phosphorus and other important soil constituents. When drained they are reasonably

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MINERAL RESOURCES OF THE KENTUCKY MOUNTAINS

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Mineral deposits form the greatest natural resource of the Kentucky Mountains. For ages this potential wealth remained practically untouched, but within about the last two decades railroads have penetrated portions of Eastern Kentucky, and the natural resources have been opened up to some extent. Even now, however, several counties have no railroads within their boundaries and large areas rich in mineral products cannot be developed economically due to lack of transportation facilities.

These mineral products of the Kentucky Mountains, considered in alphabetical order, are: asphalt rock, carbon black, cement, clay, coal (including cannel coal), coke, fertilizers, gravel, iron ore, lime, lithographic stone, natural gas, natural gas-gasoline, oil shale, petroleum, salt, sand, stone. Water resources are also important.

Asphalt Rock—This rock occurs in small areas in Carter, Johnson, Magoffin, and Morgan counties. The rock when crushed makes a valuable material for surfacing roads. Other parts of the State, however, contain far larger deposits of rock asphalt than do the Eastern Kentucky Mountains.

Carbon Black—Carbon black is manufactured from natural gas in Floyd, Lee, Whitley, Green, and Taylor counties, the first three named being in the Eastern Kentucky Mountains. Other isolated gas pools exist that can be used for the manufacture of carbon black; but, if possible, it is far better for the owners of the gas properties to sell the gas to a public utility corporation, when their pipe-line can be reached, than it is to make carbon black from the gas. Carbon black is used in the manufacture of printing inks, paints, stove and shoe polish, typewriter ribbons, and many other articles.

Cement—Limestone, clays, and shales suitable for the manufacture of Portland cement occur close together and near railroads and coal beds, in several of the Eastern Kentucky counties.

Clays—Clays and shales suitable for brick, tile and similar products are widely distributed throughout Kentucky. Within the area of the Eastern Kentucky Mountains valuable fire clays of Carboniferous age are found in the northeastern portion of the State. The area in which these fire clays are known to occur is about 660 square miles, but the deposits are not continuous and localities are found where the fire clays are missing. Development of the fire clays has been chiefly in a strip bordering the Chesapeake and Ohio Railroad. As the deposits near the railroad become exhausted operations will reach farther away from the main line of transportation. The fire clay beds range in thickness up to twenty-nine feet.

From Ashland to Haldeman there are ten plants manufacturing fire brick from the local deposits of fire clay. These plants are located at Ashland, Hitchins, Grahn, Olive Hill, Hayward, and Haldeman, and their total daily capacity is 445,000 nine-inch brick. Also, at McCall, Greenup County, there is another plant with a capacity of 40,000 brick. Large quantities of fire clay are shipped to Louisville factories and other plants outside of the Eastern Kentucky area.

Coal—The Eastern Kentucky Coal Field covers an area of 10,450 square miles, in which are thirty-seven counties. Of these counties twenty-one are actually producing coal. Bituminous coals of various grades occur. Those of southeastern Kentucky are of especially high grade, low in sulphur, low in ash, and

high in volatile matter. Heat values range from 13,000 to 14,000 B.T.U's. Much of the coal of Eastern Kentucky is suitable for coking, and bee-hive ovens are located at some of the mines, while at Ashland is a large by-product coke plant.

Geologically these coals are all of Pennsylvanian age. Numerous seams of various thicknesses occur, often one above another separated by solid rock. In the Coal Field, as a whole, there are ten seams of major commercial importance and many more of lesser importance. For instance, the total aggregate minimum thickness of coal in Harlan County is about forty feet, with individual coal seams up to eighty-four inches in thickness. Bell County has thirty different coal seams, ten of which are workable. Similar conditions occur in many other counties.

In addition to the ordinary bituminous coal described above, the best cannel coal in the United States occurs in Kentucky in individual seams of pure cannel, and also sometimes forms a part of the main seam of ordinary bituminous coal. These cannel coal seams are so important that Kentucky produces more cannel coal than any other state.

The method of reaching the coal in Eastern Kentucky is chiefly by drifts, due to the dissected topography of the region which has left many valuable coals high upon the mountain sides. The mines range from the small operation of the farmer who digs into the coal bed solely for his own needs to the electrically operated mines of the coal corporations, one of which has a tipple that cost over a million dollars. The coal is taken to market over the Chesapeake & Ohio; the Baltimore & Ohio; the Louisville & Nashville; the Southern; and a few short line roads. Some coal is barged from Lee County down the Kentucky River.

The Eastern Kentucky coals are used principally in by-product coke plants, in illuminating gas plants, and for domestic fuel. Bee-hive oven coke is also made at some of the mines.

Large areas of coal lands yet remain so remote from railroads that the coal beds have not been developed. With the coming of the railroads these lands will greatly increase in value.

Coke.—This product has been mentioned under the topic Coal.

Fertilizers.—Marl occurs in abundance in the Knob Belt, which borders the Eastern Coal Field on the west. Glauconite, a green rock containing potash, has been found in Jackson and other counties.

Gravel.—Gravel is obtained from the weathered outcrops of conglomerate rock and from stream deposits.

Iron Ore.—This ore occurs along the northwestern margin of the Eastern Coal Field, and in the northeastern part of the State, which is also in the Kentucky Mountain area. The ores are siderite, hematite, limonite. They formerly were worked, but competition with the high-grade ores of the Lake Superior and Birmingham districts compelled the Kentucky mines to close. In the future, when the high grade ores of other states are exhausted, the Kentucky iron ores will once again be worked. They are therefore a potential source of wealth.

Lime.—Limestone suitable for the manufacture of lime occurs at various places where railroad transportation is obtainable.

Lithographic Stone.—Limestone of this variety occurs in Rowan and Estill counties of Eastern Kentucky.

Natural Gas.—In the Eastern Kentucky region there are sixteen natural gas fields, some of which also produces oil. Gas is struck in many other localities but they have not been drilled enough to be designated as gas fields. The kind of "sands" in which the gas is found, and the structure of the rocks, are the same for natural gas accumulations as for the oil, under which subject these features are described.

Pipe lines connect the gas pools with towns and cities in Eastern Kentucky, the Bluegrass, and even more distant points. The gas in a few pools is used in the manufacture of carbon black. Without doubt, large and important natural gas accumulations still await the drill of the prospector in various regions of the Kentucky Mountains.

Natural Gas—Gasoline.—This product is

obtained from the gas of wells in certain districts. But before installing a plant to extract natural gas-gasoline from gas, the gas in the well should be analyzed to ascertain whether or not it contains this product.

Oil Shale.—The Ohio shale of Devonian age occurs in the Knob belt, and is the great source of oil shale in Kentucky. It borders the western margin of the Eastern Coal Field for a long distance and in some places is exposed in the valleys of streams that have cut back into the strata of Eastern Kentucky. The Sunbury black shale will also be a source of oil in the future. Some oil shales occur in the Eastern Coal Field but they are thin and will not be able to compete to any extent with the Ohio shale, which in many localities is over 100 feet thick. Oil shale from any formation, however, will not be used as a source of petroleum for many years to come, as the cost of extracting oil from shale by distillation is too high to compete successfully with oil from wells.

Petroleum.—In the Eastern Kentucky Mountain area there are twenty oil pools of importance. Smaller accumulations of petroleum also occur. The oil and gas are found in porous sandstones and limestones which range in age from the Ordovician to the Pennsylvanian, inclusive. The accumulations of oil and gas usually occur in rock folds called "anticlines". The crude petroleum of Kentucky is generally green in color, fluid, high in gasoline content, with a gravity of between 32 and 38 degrees Baume scale. The lowest gravity recorded is 22 degrees and the highest 51.6 degrees.

Pipe lines, tank cars, and, on the Kentucky River, barges, carry Kentucky oil to the refineries which are situated within and also outside of the Eastern Kentucky Mountains.

Large fortunes have been made in Kentucky oil, and drilling operations are continuing. In all probability new oil fields will be discovered in Eastern Kentucky and other parts of the State.

Salt.—In pioneer times salt was obtained from natural springs and wells sunk near natural "licks", so-called because the wild animals came to lick the salt from the rocks upon which it had been deposited from natural brines. In Eastern Kentucky salt was thus secured in the valleys of the Big Sandy, Licking, Kentucky and Upper Cumberland rivers. These sources of salt have long since been abandoned, although for many years salt was manufactured near Manchester, Clay County.

Today, natural brines occur associated with oil and gas, but these brines are not used to obtain salt as they are too weak to compete with the brines of New York, Michigan, Ohio, and other states.

Sand.—Glass sands in Eastern Kentucky occur in a strip which includes the region from Greenup to Pike County inclusive. They also occur in large quantities in Carter and Rowan counties. Much of this sand is obtained from pure, friable sandstones of Carboniferous age. It is also secured in large amounts along the Ohio River and its tributaries.

The glass sand is shipped to glass manufacturing plants outside of the Eastern Kentucky Mountains. It is, in addition, used as building sand, and for numerous other purposes. The great accumulations of natural gas in Eastern Kentucky, together with the enormous deposits of excellent glass sand available, make the establishment of glass manufacturing plants a possible industry in the future.

Molding sands of value are found in several counties of Eastern Kentucky.

Stone.—The building stones of commercial value in Eastern Kentucky are sandstones. The best known are the Rowan and Rockcastle County "freestones". In the Big Sandy district there are several sandstones that are good for building purposes. Sandstones and limestones are obtained for local use in other scattered areas. Outcrops of rock are plentiful and stone for railroad ballast and the construction of highways is found practically everywhere.

Water Resources.—Mineral water is obtained in various counties, especially counties having Knob strata outcropping within their boundaries. Chalybeate, sulphur, and salt-sulphur waters are often found. For domestic use water is secured from springs and wells. Stream water is often contaminated, even

though clear in appearance, and is not safe for human beings to drink. A few towns obtain their water supplies from creeks which are fed by springs coming from sandstone strata, the drainage areas being so unfrequented by man and animals that the water remains pure. Some towns have chlorination plants.

The development of hydroelectric power is possible on some of the tributaries of the Cumberland River, but here as elsewhere in Kentucky, commercial power cannot be obtained economically without the construction of storage reservoirs. Cumberland Falls and the river valley above the Falls form an excellent place for the building of a dam, the formation of a great reservoir, and the generation of electricity on a large scale. A dam 87 feet high at the top of the Falls would create a pool which would extend to Williamsburg. The Falls at low water have a drop of 68 feet, the total head for Falls and dam being therefore 155 feet. Two more dams have been contemplated which, if erected downstream from Cumberland Falls, would give a total hydroelectric capacity at the three dams of about 150,000 horsepower. The power interests are, of course, favorable to the development of electric power on the Cumberland or its tributaries. Many people, however, wish to keep Cumberland Falls in all its natural beauty, untouched by man in any way, and to include it in a park area.

In addition to the mineral and water resources that are of commercial value described in this article, there are minerals that are of no economic importance due to the limited amounts in which they occur. In the future, however, prospecting may disclose large deposits of these minerals which today are of no value. Gold and silver in economic quantities have never been discovered.

The non-metallic minerals of Eastern Kentucky that have enriched the land owners and the capitalists who developed the deposits, have been especially coal, petroleum, natural gas, fireclays, and to a smaller extent the other commercial minerals mentioned above. Large areas of mineral land yet remain undeveloped and await the coming of the railroad before they can be of much value to the owners of the land. Eastern Kentucky, from a mining standpoint, is a land of promise.

GEOLOGY OF EASTERN KENTUCKY SOILS

(*Continued from Page* 13)

productive, however, particularly if flood waters occasionally leave good silt cover. In all low and poorly drained places, of which there are a good many, these soils remain heavy and unproductive. The comparative values of residual and transported soils are well-known to the native farmer of eastern Kentucky, who, until recently, has generally insisted on placing the public roadway in the waters of the small creek or branch whenever possible so that every bit of tillable bottom-soil might be conserved.

The Eastern Kentucky coal-field may be divided as has been suggested into two sections for convenience in agricultural investigations. The basis of the division is strictly geological having to do entirely with the areal distribution of the plateau, or upland-forming Pottsville conglomerate, which over wide areas successfully resists mature dissection by the streams. The grouping follows: 1. The western margin of the Eastern coal-field where the towns, roads, habitations and farms are generally on the uplands. The counties representative of this group are: Laurel, Jackson, and Wolfe. In the second group, comprising a very much larger area, the towns, dwellings roads and tilled areas are in the bottoms, or close to drainage levels. Floyd, Letcher, Leslie, and Bell counties are representative. The following counties comprise the Eastern Kentucky coal-field: Greenup, Boyd, Carter, Elliott, Lawrence, southeastern Menifee, Morgan, Johnson, southeastern Powell, Wolfe, Magoffin, Pike, Leslie, Breathitt, Knott, Letcher, Owsley, Jackson, southeastern Rockcastle, Larue, Perry, western Pulaski, Knox, Harlan, Whitley, McCreary, western Wayne, and Bell.

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"THE PLAYGROUND OF EASTERN AMERICA"

By HARRY M. WATSON *Knoxville Chamber of Commerce*

The Greaty Smoky Mountains near Knoxville offer as fine an outlay of scenery as can be found anywhere in the world. Since the pioneer days the Great Smokies have been almost unknown, and assuredly unnoticed, but within recent years the beautiful mountain range has come to the attention of people in all parts of the nation.

The Great Smokies are the greatest mountain masses east of the Rockies. For a distance of over fifty miles, the Tennessee-North Carolina state line runs along the crest of the mountains without crossing a gap below five thousand feet. Seven majestic peaks rise to altitudes of more than six thousand feet, eleven others are almost as high. These mountains tower higher above Knoxville than the Rockies do above Denver, while Mt. LeConte rises a mile above Gatlinburg, the little town at its base. From the summit of Mt. LeConte, 6,680 feet above sea level, the gasping climber looks out upon the corners of seven states.

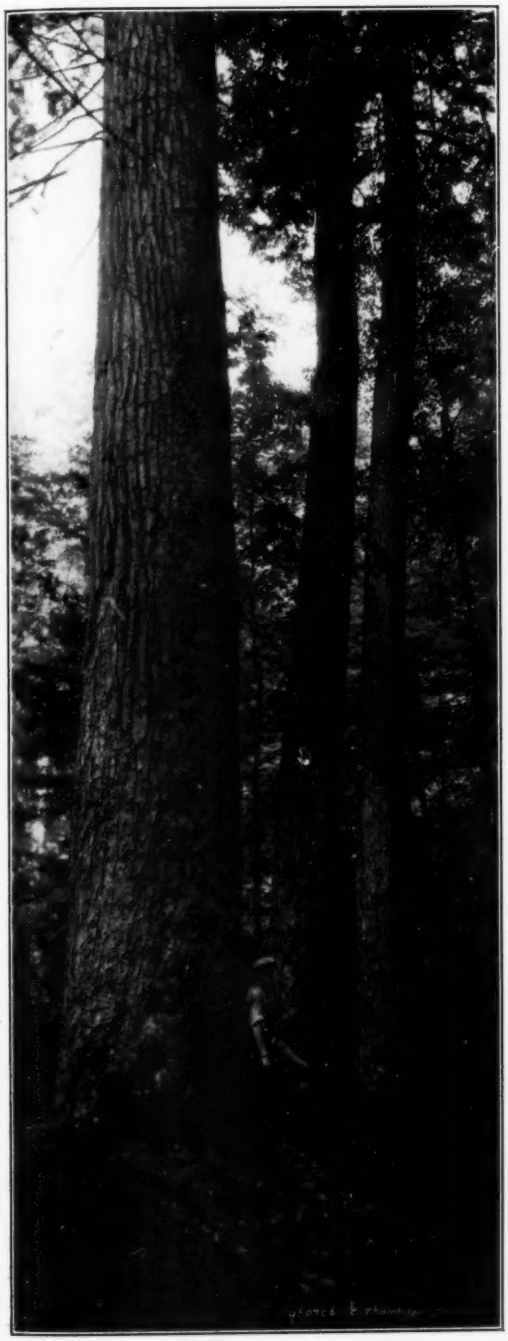
The largest tract of indigenous hardwoods in America is found in the Great Smokies. There have been recorded from the Southern Appalachian region 137 species of trees and 174 species of shrubs, and it is believed that practically all of these occur in the Great Smokies. In a week-end trip through these mountains a person can see more indigenous trees and shrubs than in a cross-continent trip from Boston to the Pacific, or in a European trip from England to Turkey.

In going from the base to the top of one of the high mountains in the Great Smokies, a hiker traverses the same floral zones that are to be found in a trip from Southern Tennessee to Southern Canada. Plants of the southern range, such as magnolia and sweet gum, are found in the valeys. On the tops of the high mountains, at altitudes ranging about six thousand feet, are found plants of the northern range, such as black spruce and mountain ash, both natives of Canada. Another northern plant occurring in the Great Smokies is the climbing fumitory.

The decision to establish a national park in the Great Smokies was made after the Southern Appalachian Park committee, appointed by Secretary of the Interior Hubert Work, reported on the basis of their investigation of a number of localities that "the Great Smoky Mountains easily stand first because of the height of the mountains, depth of the valleys, ruggedness of the areas, and unexampled variety of trees, shrubs, and plants." The announcement in March of a gift of $5,000,000 by the Laura Spelman Rockefeller Memorial to the Great Smoky Mountains National Park fund practically assured the establishment of the park. The park commissions of Tennessee and North Carolina are now engaged in purchasing tracts of land in the designated area. With a minimum of 427,000 acres, this park will be fifth largest of the twenty in the national system. And with the establishment of the Great Smoky Mountains National Park, the natural beauty of this fascinating mountain range is being preserved for future generations to enjoy.

Wild life abounds in the Great Smokies. There are black bears and wildcats, countless gray squirrels, a few lynx, an occasional deer, and more than 160 species of birds, among them being the ruffed grouse, the raven, the wild turkey, and the eagle. Brooks teem with trout.

The natives of the Great Smokies are an interesting people. They are descendants of that sturdy band of Anglo-Saxons who blazed their way into the mountain wilderness of the Appalachians. Words current in Shakespeare's time are still current among the mountaineers. They sing ballads three hundred years old. And the women weave textiles in



By Permission Knoxville Chamber of Commerce

Giant Tulip the "King of the Smokies"

old patterns brought from England.

A few Cherokee Indians live within the park area. They are the last of that group who resisted deportation to the Indian territory. About two thousand in number, these Indians of the Qualla Indian Reserve will retain possession of their abodes within the park, and will there be objects of interest to millions of tourists.

With the sole exception of a little eight-mile tract on Mount Desert Island, there is no national park east of the Mississippi. This new park area in the Great Smokies is halfway between the Mississippi and the Atlantic, halfway between the Great Lakes and the Gulf of Mexico, and halfway between New York and New Orleans. Good roads lead from Knoxville and Asheville, the two largest cities near the park area, into the heart of this beautiful mountain region, which has been termed "The Playground of Eastern America."

When the development of the park is completed, throngs of motorists, mountain climbers, hikers, campers, and nature lovers will seek the Great Smokies for escape from the summer heat, for rest amid incomparably beautiful surroundings, for the thrill of sojourning above the clouds, and for the spiritual exaltation of companionship with Nature in all her glory.

"Set your feet fast in the common soil. There are the roots of life. There you must learn to stand. Begin on the plane of every day—not in the blue of heaven—and grow upward. Must you not plow the field before you gather in the harvest? Love life. Hate no one. With joy and sorrow, hope and faith, you shall build here on earth a bridge up to the stars."—(*A free translation of a favorite folk-school song.*)

"The living center and essential of the folk school seem to me to be these—a deeply religious motive and a purely democratic base, or if you will, a real love for the people which is the purest kind of democracy and religion. Without them personality is only capitalized power."

—The Danish Folk School
Olive D. Campbell.

THE STUDY of GEOLOGY FOR ITS CULTURAL VALUE

By SAMUEL M. MAYFIELD

The Southern mountaineers who a generation ago parted with valuable coal lands for fifty cents an acre had never studied geology. That others may recognize and properly evaluate the economic factors of their native hills has been given as sufficient reason for the more general study of this basic science. There are also those who would develop professional geologists in the mountains with a view to their taking part in the exploration and exploitation of the mineral resources of Appalachia. But training for geology as a profession should be given only to young men who are preeminently fitted for it and who are so determined to be geologists that they cannot be dissuaded from it nor attracted into some other field of study and endeavor, for the profession is and has long been over-supplied with workers. Yet on the basis of these economic considerations alone we should be justified in asking large numbers of students in college and senior high schools to take at least one course in elementary geology.

Add to these economic considerations the tremendous power of dynamic, historic and paleontologic geology to stimulate the imagination, broaden the mind, and elevate the spirit of young people, and we have an informational, culture-instilling combination of incomparable value. Nor should instruction in geology be confined to the college and high school. It should be so popularized through literature, lecture, and discussion that a large fund of information in regard to earth science would become the common property of many mountain people.

The natural environment of the mountaineer is such that throughout his life he is constantly dealing with and thinking about geologic phenomena. Rocks play a part in every phase of his life; interesting topographic features are all about him, and geologic processes are active everywhere. Thus surrounded, the observing young mountaineer becomes an animated question mark. He observes the different kinds of rocks, and wants to know why they are different, and how they came to be as they are. He notices that the sedimentary rocks occur in layers while the igneous rocks are massive and he asks why. He sees a coal seam lying between the rocks in a mountain and he asks how it got there. He sees the valley, the hill and the mountain and wants to know how they were made. He finds embedded in limestone the fossilized remains of animals, he goes into the coal mine and hundreds of feet beneath the surface finds fossilized stumps and trunks of trees, he sees the imprint of leaves upon the slate or shale—and he wants to know what these mean.

Here is a situation which every true teacher should covet. Never was there better opportunity to take the student where he is, and beginning with his stock of knowledge, experience and interests, develop him through and by means of his intensely interesting environment. Never was there a subject which a larger percentage of students would study for the love, the joy, of learning; and there is no study which will yield quicker and larger returns in mental, cultural and spiritual development than will geology when rightly taught.

Possibly the brightest memory in the "scholastic career" of the writer is that of his first course in geology, conducted by a great mountain teacher. Under the wise guidance of this Christian educator and scientist, the student's cosmography expanded—exploded—into tremendously enlarged proportions. It was like stepping from long confinement in a windowless room onto a mountain top by the sea on a cloudless day. The mind ceased the petty consideration of time in small units and began to grapple with eons and with eternity; the narrow walls and enclosing hills moved back and space stretched away to infinity; the

inner eye, looking upon the familiar rock, now perceived the eternal elements, changing, forming, cycling on and on forever; that mysterious principle called life appeared on the dim far horizon and advanced onward and upward through the ages toward some divinely appointed goal, and, in it, through it, over it all was the infinitely great God, initiating, guiding, controlling, loving. Universal unity was revealed. Is there any subject that will do more to help a young person locate himself in the scheme of things, that will bring a better understanding of things as they are, that will awaken a greater desire to have things as they ought to be?

All this can be done through geology better than through any other subject because geology is THE fundamental study, the subject back to which, in the final analysis, goes everything terrestrial. Trace anything you please back to its beginnings and you will find it literally rooted and grounded in geology. All earthly entities, animate and inanimate, mental and, perhaps, even spiritual, live, move and have their being under the modifying and conditioning influences of this basic department of earth science. With this intense natural interest stimulated by an inspiring teacher, the student is ready to enter enthusiastically into any field of study which may be approached from the central theme of geology.

Are you not persuaded to agree to the proposition that we should popularize the study of geology among the mountaineers and people everywhere, and that no student should be allowed to go beyond the freshman year in college without having an elementary course in earth science, even at the sacrifice of Latin, algebra or some other time-honored vehicle of culture?

Our mountain people are just coming out of mental bondage imposed by isolation. The transitional stage through which they are passing has many dangers. Wise, sympathetic understanding and broad-minded guidance are all-important in helping them through to the largest realization of the meaning of life and its possibilities. Here religion in its best, finest and truest sense should enter and be the guiding motive in every department of instruction, and more especially in those sciences such as geology which have been more or less related in the past to the religious ideas of the people. It is very important that the mountain youngster be carefully guided in his journey from the simple religious ideas of their isolated forefathers to the larger religious concepts of the educated man of the world. There must be no definite break in the process; one must be made to grow into the other. In this I am saying that teachers, and especially science teachers, should be religious people—Christians of the finest type. For, as William Jennings Bryan said, "Religion is the dominant chord in every human life, and life is a success according as that chord rings true."

Unfortunately the study of geology has thus been regarded as belonging strictly to the college. There are very few colleges devoting much of their time and energy to the training of mountain students, and some of these do not have departments of geology. Those colleges which do offer courses in geology, the state universities for instance, give most attention to the economic phases of the subject. Possibly there are not over a half-dozen geology teachers who have any considerable number of Southern mountain students in their classes, and most of these are stressing the economic side of the subject. Thus it seems that, in the mountains, instruction in geology from the cultural point of view is practically non-existent. The great interest in this field, with its almost infinite possibilities, is allowed to die or to find satisfaction in tradition, as the generations come and go.

It is hard to suggest an effective program for remedying this condition. But could it not be started by a few key institutions adopting courses so very popular, so intensely interesting and so exceedingly human and adaptable that the students attending those classes would go back to their homes so filled with the subject that they would seek every opportunity in high schools, social gatherings, and conversation to pass on to their people some of the wonderful things that they have learned, without offending and without arousing controversy?

(*Continued on page twenty-eight*)

TOPOGRAPHY AND GEOLOGY OF THE SOUTHERN APPALACHIANS

By ARTHUR KEITH
United States Geological Survey

That portion of the Southern Appalachian Mountains in which it is proposed to make a national park . . . can be reached within a day's journey from the large cities east of the Mississippi, a measure of accessibility possessed by no other similar district in the United States. It is also nearer the center of population than any other mountain district.

Although this region contains many large rivers and important valleys, it is preeminently a region of mountains. It includes the largest areas of land over 5,000 feet in height east of the Mississippi. In all, 46 peaks a mile or more apart and 41 miles of divide rise above 6,000 feet, while 288 peaks and 300 miles of divide are 5,000 feet or more in height. From the southeastern foot of this mass the Piedmont Plateau stretches southeastward with small interruptions, finally merging into the coastal plain which borders the Atlantic. Past its northwestern foot sweep the valleys of Tennessee and Virginia, with their included ridges and smaller mountains. The great mountain mass thus limited is composed of a number of large and many lesser chains, forming a belt over 300 miles long. Between the chains are extensive plateaus, which are themselves mountains when compared with the lower valleys that dissect them. The Blue Ridge forms the southeastern and the Unaka Mountains the northwestern front of the mountains. Seventy miles apart in North Carolina, they inclose many other extensive ranges between them. In Georgia they approach within 30 miles of each other, and in lower Virginia they coalesce.

The southeastern portion of the mountainous area is the Blue Ridge, a sinuous divide which parts the waters of the Atlantic and the Mississippi. The Blue Ridge stands above 3,000 feet in height, except in a number of deep gaps and a short stretch at the head of Broad River. The northern part of the Blue Ridge consists of ancient plateaus, whose summits are broad and gently rolling and rise to similar heights for long distances. From place to place these vary between 3,100 and 3,800 feet. Less regularity prevails in the southern part of the chain, upon which are situated a few individual peaks and ridges of commanding height. Chief of these are Grandfather Mountain, 5,964 feet, Pinnacle, 5,693 feet, and Standing Indian, 5,562 feet. Four other points exceed 5,000 feet in height. South of the Little Tennessee Basin the Blue Ridge becomes exceedingly irregular, both in height and direction, and finally merges into the Piedmont Plateau. The one feature which distinguishes the Blue Ridge from other Appalachian Mountains is its steep slope on the southeast. This is so extreme as to be, in places, precipitous, and it fronts the adjoining foothills and the Piedmont Plateau like a rampart.

Roughly parallel to the Blue Ridge and bordering the Great Valley of Tennessee and Virginia lie a series of high mountains which have many features in common and arise from the same causes, although they have separate names. These begin at the southwest with the Unaka Mountains and are continued in the Great Smoky, the Bald, the Unaka, and the Iron mountains. This northwestern front of the mountain mass is termed, collectively, the "Unaka Mountains," a name which is also applied to two of its parts. In the Smoky Mountains several points are but a few feet less in altitude that Mount Mitchell—for instance, Mount Guyot, 6,636 feet, and Clingmans Dome, 6,619 feet. From this maximum in the Smokies the Unakas have progressively lower summits in all direction. Cut apart as the segments of the chain are by the rivers, no average elevations can be stated. South of Big Pigeon

River most of the summits are above 5,000 feet. North of that river few exceed 5,000 feet, but many are over 4,000. In all, 125 of its summits rise above 5,000 feet, and 10 exceed 6,000 feet. The body of high land in the Smoky Mountains is the greatest in the Appalachians.

Connecting the Unaka Mountains with the Blue Ridge are a series of more or less interrupted chains, most of which have a northwest direction. Chief of these are Tusquitee, Cheoah, Nantahala, Cowee, Balsam, Pisgah, New Found, Black, Yellow, Roan, Beech, and Stone mountains. Supporting and extending these are scores of smaller peaks and ridges. Here and there on these separate chains are many high points comparable with or exceeding those of the Unaka Mountains—for instance, Roan Mountain, 6,313 feet; Richland Balsam, 6,540 feet, and Mount Mitchell, 6,712 feet, the highest point east of the Rockies. As a whole they are much higher than the Blue Ridge, although they exceed the Unakas but little. One hundred and fifty-six summits are over 5,000 feet, and 36 rise over 6,000 feet. The Balsam and Pisgah mountains are the highest of the transverse ranges and form a maximum corresponding to the Smoky Mountains.

Thus, although the Blue Ridge is the watershed of this area, the highest points, excepting Mount Mitchell, are situated in the Unaka Mountains, where are also located the largest bodies of high ground. Accordingly the rivers flow northwest from the Blue Ridge in deeper and deeper channels, until their gorges are overshadowed by the peaks of the Unakas, a mile in height above them.

Certain types of surface prevail throughout the mountain district. The mountains rest upon a low base, which varies from 1,500 to 2,500 feet in elevation. The rise of 2,000—5,000 feet up to the summits is made between narrow limits, so that the slopes are steep for the most part. Narrow valleys follow the rivers, in places from 2 to 5 miles in width, and with moderate eminences. From their borders rise the mountains, with slopes abruptly changing 20 degrees or more. These have a marked similarity throughout the mountains, whether high or low. The summits are usually rounded, and cliffs only here and there mar the smoothness of the slopes. The general aspect of these mountains is one of flowing curves, and their grandeur is impressed on the observer by their mass rather than by outline.

The "Chimney Tops" in the Great Smoky Mountains. By Permission Knoxville Chamber of Commerce

Probably no region in the United States is better watered or bettered drained than this. Most of the water passes into the Mississippi, through the Tennessee River and its tributaries. Chief of these are the Ocoee, Hiwassee, Little Tennessee, Tuckaseegee, Big Pigeon, French Broad, Nolichucky, Watauga, and Holston rivers. These all flow from the Blue

Ridge northwestward through the Unaka Mountains and separate that chain into portions which have received individual names. In the northeastern portion of this region the New River, a branch of the Ohio, rises and flows northeastward. Southeastward from the Blue Ridge a large number of rivers flow into the Atlantic. These are the Yadkin, Catawba, Broad, Saluda, and Chatooga rivers. In the northeastern corner of Georgia rises the Chattahoochee, flowing southeastward into the Gulf of Mexico. Thus this region distributes its waters in all directions and is practically the apex of the drainage of many thousand square miles. From the Blue Ridge near Blowing Rock the waters may run through the Watauga River into the Tennessee, through New River into the Ohio, or through the Catawba and the Yadkin into the Atlantic. From the Blue Ridge near the head of Hiwassee River they may flow through the Chatooga River into the Atlantic, through the Chattahoochee into the Gulf of Mexico, or through the Hiwassee into the Mississippi. Into these large rivers flow hundreds of lesser river and creeks, which cover the country with a most intricate network. They are fed by myriads of springs which run from year to year with unceasing flow.

Starting southeastward from heights of 3,000 feet or more, the streams tumble rapidly from the Blue Ridge and reach the Piedmont Plateau at heights from 1,000 to 1,500 feet. Rivers running in the opposite directions emerge upon the Appalachian Valley at heights from 1,000 or 2,000 feet, the highest points being at the northeast. Few of these rivers flow as far as 100 miles in the mountains, so that this fall of 1,000 or 2,000 feet makes a very high average grade. The stretches of smooth water are seldom long, and the descent is mainly accomplished by countless rapids and minor falls. On the larger rivers few falls exceed 10 feet. Falls of 25 and 30 feet can be found here and there upon the smaller rivers, while in places the creeks and branches have direct plunges as great as 300 feet. That the scenery along the streams is picturesque scarcely needs to be said. From rapid to fall and then a stretch of placid depth, the courses of the streams are pictures of kaleidoscopic variety. Come to them where you may, the charm is there, and fresh beauties are viewed at every bend.

From season to season the rivers vary in flow. Their least volume is in the early fall, when they have been reduced by the droughts and heat of summer. Only the smallest branches are ever entirely dried, however, and the severest droughts fail to stop any considerable stream. The greatest volumes are attained in the spring, when the snows melt rapidly and the winter's accumulation of water is leaving the soil. The freshets are not limited altogether to the spring, however; a cloudburst, for example, may swell a lesser stream tenfold, or a hard rain of four or five days may flood even the largest river. In the upper courses of the streams, where the grades are highest, floods produce exceedingly swift currents, which are able to destroy obstructions and barriers which at ordinary stages would seem insurmountable. The rapid delivery of the waters from the stream heads makes a sudden concentration where the branches have united and the grades are less, causing deep water and overflow. The power of the upper and steeper streams at such times is almost incredible; bowlders tons in weight become mere playthings. On the lower reaches in deeper waters and slackened currents no fragments larger than cobblestones are moved, but wholesale changes in the shapes of the bottom lands are often accomplished. The same steep grades which cause the rapid floods are equally effective when the rains have ceased, so that the waters subside about as quickly as they rise. Aside from these temporary changes in volume the flow of the rivers is very steady, dependent as it is upon the discharge of countless springs and the seepage of waters from the soils.

The region covered by this mountain mass possesses a climate which differs greatly from that of the surrounding regions. This is manifest first in lower temperatures and is due directly to the greater altitudes. The peaks, of course, are colder than the intermountain valleys, and both are colder than the adjoining Great Valley or the Piedmont Plateau.

The differences in temperature are greater in summer than in winter, so that the climate of the higher portions is more equable than that of the valleys.

In addition to the cold which it directly produces, the altitude also affects the climate of this region very decidely through the precipitation. The prevailing winds of the region are southwesterly and are heavily laden with moisture derived from the Gulf of Mexico. As these winds rise over the mountain slopes they become colder and less able to retain moisture, which comes within the mountain's grasp as rain or snow. The birth of shreds of cloud in the uprising wind and their union into masses that shroud the mountains can be seen on every hand. Through them come glimpses of peak and forest, in a softness and beauty far beyond words. The direct effect of altitude in chilling the winds is assisted by the cooling effect of the almost universal forests. The forests in turn are fostered by the rainfall and humidity, and the two processes go hand in hand. In the winter much of the precipitation is in the form of snow. This is protected from melting by the forest cover and accumulates so as to mantle the ground for weeks, or even months. In this way a great store of moisture is retained and finds its way into the soil, to be absorbed in part by the forests when growth begins in the spring. Snow sometimes falls on the higher mountains by the first of October, and the last snow may remain until the middle of March.

Between the temperature of the highest tops and that of the larger and lower valleys included in the mountain region there is a great difference. This is expressed in nature most prominently by the great variety of trees, shrubs, and plants. There is probably no region in the United States containing more species than this, which is appropriately termed the "botanist's paradise." During May and June it becomes a vast flower garden of unrivaled rarity and beauty. Rhododendron and azalea bloom mile on mile, or a score of blossoms are trodden at a step. In autumn the purple haze and the blaze of the color in the foliage form a panorama than can not be surpassed. The amount of the forest is quite as striking as its variety, and is one of the most impressive features of the mountains. Owing to the warmth and humidity of the atmosphere the individual trees attain great size. White pines reach heights of 200 feet and poplars are 25 feet in girth. Thus, the existence of the forest cover as a whole and of the individual species that are favored by colder climates is dependent upon the altitude, which cools the air and brings moisture to the surface of the earth. Its favorable situation with regard to the moist, warm winds from the Gulf combines with a general altitude unequaled east of the Mississippi to produce a unique and remarkable vegetation.

View of Clingmen's Dome from the top of Mt. Le Conte

The Geologic Formation

The geologic formations which underlie this mountain district may be divided into four large groups. Each differs widely from the others in age, and has very distinct features of its own. These broad differences have expressed themselves in such major topographic features as the Appalachian Valley, the Appalachian Mountains, and the Piedmont Plateau. These differences are also largely responsible for the principal variations in the character of the surface in the mountain district itself.

The Appalachian Valley is underlain by a series of limestones, shales, and sandstones, mainly of late Cambrian and Silurian age, forming the youngest of the four groups in this region. Small outliers of these formations are included within the area of the mountains near the border of the Appalachian Valley.

The second group occupies the northwestern border of the mountain district, chiefly northeast of the French Broad River. It consists of a series of quartzites, sandstones, conglomerates, and shales of Lower Cambrian age.

The third group is of Cambrian age. It occupies the northwest border of the mountain mass, corresponding in position to the previous group but best developed southwest of the French Broad River in the Smoky and Unaka mountains. The group consists of conglomerates, graywackes, sandstones, schists, and slates, and is called the Ocoee group. This and the preceding two groups were composed of the waste from older rocks, which was deposited under water. The thickness of the strata is approximately the same in the Ocoee group and the formations of the Appalachian Valley. The Lower Cambrian quartzites and shales of the second group have only from one-fourth to one-third of the thickness of either of the preceding groups.

The fourth group is much the largest of all, both in actual bulk and area. It consists in the main of formations of the Archean, or oldest known age. The different rocks include several kinds of granite, diorite, mica-gneiss, hornblende-gneiss, and various schists. A large number of these are of igneous origin, but the original nature of many of the gneisses and schists is unknown. Formations also included in this group are the ancient volcanic rocks. These are developed most prominently in connection with the Cambrian quartzites in the northeastern part of the mountain district.

Relation of Rocks to Surface

Much of the surface of the Appalachian Mountains is exceedingly ancient. During the later geologic periods it has been subjected to the various natural agencies of destruction and has been worn down according as the rocks presented at the surface were susceptible to these influences. The materials composing these formations are attacked in varying degrees by solution and by chemical processes connected with atmospheric and underground water. Certain minerals—for instance, carbonate of lime—are readily dissolved by natural waters, and the rock in wasting away leaves behind only the less soluble portions in forms of clay. To this capability is directly due the reduction of the Great Valley below the mountain mass. Other minerals—for instance, feldspar—are in part dissolved and in part chemically altered and decomposed by natural waters, so that the coherence of the rock which contains them is largely destroyed. Two groups in this region have a large proportion of feldspar in their makeup, and their surfaces have been gradually lowered by its breaking down. These are the Ocoee group and the Archean group. A third mineral—quartz— is comparatively little changed by solution or chemical action near the surface. Formations made up in large part of this mineral retain their altitudes most persistently and are usually the last to be reduced. This composition is most pronounced in the Lower Cambrian group, but is shared also by the Ocoee group and the Archean group. Although the thickness of the lower Cambrian quartzites is so much less than that of the other groups, their resistance to solution has caused them to remain upheld in very high ridges and peaks. To this are due the cliffs of Chilhowee, Camp Creek, and Iron mountains and the rugged crags of Grandfather. In the case of the Ocoee and Archean groups their immense thickness and the amount of quartz

which they contain have maintained the greatest elevations presented in this region. Of this the mighty domes of the Smokies, the Balsams, and the Roan, and the lofty peaks of the Blacks are witnesses.

The moist atmosphere is conducive to the rapid decay of the rocks, which break up chiefly under the attack of the rain, frost, the roots of the trees, the underground waters, and organic acids. At first decay works in along the various partings, resulting in the loosening of large masses, which gradually become smaller, until finally nothing is left of them except clay and the more obdurate bits of rock. The rocks reach the surface only over very small patches, while in places the disintegration attains a depth as great as 50 feet. On sloping surfaces the loose material is maintained in its place solely by friction. When this is lessened or overcome from any cause, the residual matter, be it clay or rock fragments, slides down the slopes until the friction is again sufficient to retain it in one position. Thus are formed immense thicknesses of loose material washed down from steep slopes and accumulated in the hollows and flatter places. This material gradually works its way downhill as it is pushed along by the freezing of the water which it contains, or is rendered more unstable as the water transforms it into mud. Eventually it finds its way into the streams and is carried by slow stages into the sea.

Protection of the Soils

The chief agent which checks this process of removal is forest cover, even though the penetrating roots and the acids due to vegetation induce rock decomposition. These same roots, however, hold the loose material in place and hinder its tendency to slide downhill. With this assistance loose soils are upheld on slopes at angles fully double those which they could maintain unaided. Besides this direct check to the waste of slopes by increased friction, the action of the forests is as great in another way. Loose materials are washed downhill during rainstorms by even the tinest rivulets. In open fields these gather in a few minutes and form deeper and deeper channels with each succeeding storm, finally removing the loose material down to the bare rock. This process is almost wholly prevented by the network of roots and the cover of leaves, both living and dead, and the water concentrates into rivulets by seeping through the soils so slowly that it carries no sediments. The waters drain off in the hollows and small streams whose channels have been fitted by long use to withstand the attacks of rushing water.

Countless illustrations of this process can be seen during any rainstorm. Streams which drain considerable areas of cleared land rise fast and become turbid with mud. Those which drain areas protected by forests rise much more slowly, and by comparison the water could be called clear, except in the most violent storms. This result is of course most striking at the very headwaters, the little streams rising in the fields and in the woods. The effects of this work are seen in the innumerable gullies which gash fields left to the elements for any time. In fact, unless checked by the most constant attention, these gullies soon strip off the soil and clay and ruin the fields. In the forests, on the other hand, one rarely sees a slope of soil not covered by vegetation, and it is only along the immediate banks of the streams that raw slopes of loose material are exposed. In short, in this region of deep residual soils the influence of the forest is paramount. It is a fact well known among the mountaineers that the soils are far more fertile when first cleared of timber than ever again. It is equally well known among the farmers along the river bottoms that the same crops have been planted with the same success for scores of years. These latter soils, however, are refreshed from time to time by the overflowing waters, which have swept off fertile materials from the steeper slopes above. The natural fertility of these mountain soils is very great, as is abundantly shown by the tremendous forest growth. The pristine strength of the soil soon wanes in the clearings, and there ensues a loss which is permanent for at least a generation. To convince one's self of the existence of this condition it is only necessary to visit the region.

In addition to the loss inflicted by forest cutting upon the steep slopes themselves great

damage also results to the lands lying farther down the streams. The deep clays and underlying rocks form a kind of a gigantic sponge, which stores up water when it is abundant. When the forests are stripped away the water collects and runs off with vastly greater speed, and much evaporates, so that not only is less stored up, but the discharge is more irregular and temporary. Destructive floods result and droughts are wider spread. Thus, viewed from the standpoint either of utility or beauty, these unrivaled forests are the keystone of the arch.

EDITORIAL

(*Continued from page one*)

mountain counties will be very different from their past or present.

Within the mountain territory, as Mr. Keith and Mr. Watson point out, nature has laid out an area ideally suited to become a great national park. As an ever-increasing number of people respond to "the lure of the Great Smokies" and get better acquainted with the region, they will come to appreciate, not only its re-creational advantages, but its material and human resources, its physical and spiritual "raw materials." Some of them may even see here the makings of tomorrow's happy industrial communities: decentralized and socialized industries in which the producer is held of more value than the product, abundant-life communities in which the prophets of God loom larger than the profits of gain——We may have stepped into the clouds here; but Mr. Watson says that down near Gatlinburg one can be a mile up in the air and still be on solid ground. Anyhow, industrial development is the topic for a later issue of Mountain Life and Work.

—Orrin L. Keener.

THE STORY OF GEOLOGY FOR ITS CULTURAL VALUE

(*Continued from page twenty-one*)

In most of the attempted instruction in geology in the past we have begun with the one per cent which is offensive to the mountaineer instead of talking of the ninety-nine per cent about which he is anxious to hear. With a little tact and much insulation against argument, one can arouse enthusiastic interest in geology in the most set and "unteachable" mountain mind.

We are much concerned at this time with questions of economy and conservation. Here is a highly valuable educational resource which is being almost utterly wasted. Cannot we who are interested in education devise some plan whereby we can utilize some of this resource for the enrichment of the lives of the people whom it is our passion to serve?

ANCIENT MEN OF THE MOUNTAINS

(*Continued from page ten*)

tered and the artifacts thrown away in order to secure a few flints or "Indian arrowheads." Ancient graves are rifled in the hope of finding a "pot of gold" or other valuables, when of course, the aboriginal savage had no treasure beyond his pathetic string of shell beads or crudely fashioned bone or stone decorations.

The excavation of a prehistoric site or grave must be made with great care. The plane-table map of the site must be accurate; the orientation and position of the skeleton must be carefully noted; the positions of the soil layers must be studied; the presence of intrusive objects must be recorded; the earth must be carefully sifted so that no small shell or stone may be lost; good photographs must be secured from at least two positions; finally, if the bones are to be moved, they must be treated with chemicals so that they will not crumble to dust when exposed to the air, and each separate bone must be labeled and carefully packed. Naturally such work must be done with other tools than a crude pick or shovel and by other hands than those of an unskilled laborer.

It is most discouraging to realize that the average individual apparently knows little and cares less about the ancient history of his state. These ancient men of the mountains will never again come to build their mounds and leave us the evidences of their cultures. If we once destroy these evidences, they are destroyed forever. Let us appreciate and preserve them.

BOOK REVIEWS

"THE LURE OF THE GREAT SMOKIES" —*Mason*

The recent acquisition of an area in the Great Smoky Mountains for a National Park is a matter for wide-spread rejoicing, since it makes certain the conservation of one of the most interesting regions in America. Oldest of mountain formations on our continent with the most widely varied vegetation in the world: at base a mighty monolith 65 miles in length, with numerous peaks 5000 to 6000 feet high, and covering an area of over 700,000 acres: beautiful, majestic, awesome, with vast unexplored depths and heights: rich in ancient traditions, holding heroic place in the making of American history, the Great Smokies claim the profound interest of the scientist, the historian, the artist, and the lover of the great outdoors.

Timely in relation to the National Park movement came Robert Lindsay Mason's book, The Lure of the Great Smokies, (Houghton, Mifflin & Co. $4.50). With no claim to the making of a comprehensive study the author has assembled information which gives his book not only current but also historical interest. Mr. Mason was born in the Tennessee mountains and through childhood lived within sight of the Smokies. He is an artist by profession but has devoted his time in recent years to exploring the mountains and assembling data concerning them.

The volume is highly readable, though minor faults sometimes appear. Some of its readers will wish that an index had been added, and others will wonder why the last chapter, which lacks the tone of the vivid foreword and of the main body of the book, was not subjoined simply as appendix material. The book contains good maps and is generously illustrated with photographs mostly by the author.

The reader who has once glimpsed the grandeur of those heights will readily recall the picture as he reads in the foreword of a sunset. "No artist could paint it. To do so he would need to compete with the Master Painter using the heavens for a canvas, the sunset and rainbow for a palette, purple mists and winds out of the west for brushes, and sweep space with the technique of the Creator to limn the titanic picture across the universe."

In the opening chapter Mr. Mason tells of the movement to secure the Great Smokies for a National Park. Of special note is the fine work done by North Carolina and Tennessee in promoting the plan. Succeeding chapters deal with the geological story, the natural features of the wilderness region, the origin of the name "Smokies," Prof. Guyot's work in measuring and charting some of the peaks, the migrations of Angle, Scot, and Celt, the struggles of the pioneers against the Indians and their English, French, and Spanish allies, the religious background of the mountain people and their home life.

Those who know the mountain people well will appreciate the author's characterization: "Lean lines of strength work the faces and bodies of the mountain people accustomed to climbing steeps physical and spiritual. There is in their demeanor the quiet courtesy that takes every one at his true worth, devoid of blandishment or pretense: that expects a return of honesty and hates evasion or equivocation; that is ready and instant in hospitality to the stranger. They hate dishonesty with a quiet, simple hatred that says little, but the honest man may always expect to receive genuine and warm consideration."

The author pays a worthy tribute to the cabin of the pioneer, "The frontier cabin of America should be emblazoned on her coat of arms. The historical movement of this cabin across the whole American continent . . . has always heralded the vanguard of civilization. . . . It is individual. It is like no other cabin on earth. It appeals to every true American and awakens quickened visions of upstanding men, fearless fighters, determined home-makers, invincible republic builders. At once it suggests danger, hardship, endurance, and courage: poverty also, but happiness. It suggests clean-mindedness and good citizenship. It implies the lack of the sordidness which often goes hand in hand with the wealth

of a country. . . . It has its appeal for Americans because, somehow, they feel that they were better men in those homes."

In the chapters "Old Time Smoky Mountain Rifles and Riflemen" and "The Old Smoky Shooting Match," Mr. Mason has a new assembly of historical material which throws unusual sidelights upon certain phases of mountain life.

"The very fact that the southern mountain frontier gunsmith and marksman could manufacture, at his crude forge, with its scanty, home-made equipment, a short-range firearm of comparatively unvarying accuracy and hard-hitting qualities, is extraordinary and no feat to rival it is found anywhere in history."

"In his case, necessity was the actual progenitor of a gun. . . . Every cabin of the Smokies possessed this valuable weapon which meant everything in the establishment of a home in the wilderness. . . . The more effective the weapon and the surer the woodsman's aim, the greater the stability of all things, including even government."

Further chapters tell of the famous hunters of the Smokies, of the devastation wrought by the dollar-mad in the destruction of the forests, and of the revenue raids.

"It might be useful to know that, generally speaking, practically all mountain women are against 'blockading.' In this they are probably a century ahead of their liege lords" (and of many others of their fellow-citizens throughout America, it may be added). He further states that "very few stills can flourish long within sight of a church if the organization is active (a statement which has wider applicaplication than to the mountain region).

Throughout the book is found much information about the Indian tribes of the Great Smokies. In the chapter "Old Cherokee Tales and Legends" he gives illustrations of the picturesque imagination of these Indians. "Some of their wonder stories rival even those of Arabian Nights."

"The Cherokee Indians' stories of the Rabbit and the Tar Baby were never taken, as is erroneously supposed . . . from the negro tales." Probably the reverse is true, for "the Tar Baby story had generally existed among all North American Indians for centuries before the advent of the negro."

—Florence Holmes Ridgeway

"THE DANISH FOLK SCHOOL"—Campbell

To those who are questioning the standardized methods of present-day education, and who are discouraged with some of the disintegrating trends in the rural social life of our country, "The Danish Folk School" by Olive D. Campbell (Macmillan Co., New York, $2.) will give new hope and courage. Next best to a trip to Denmark to see for oneself is to read this revealing study of rural education in Denmark. In a remarkable way Mrs. Campbell has caught the meaning of the folk schools—their deeply spiritual values and their impact upon rural social life. As I talked with the leaders of the movement in Denmark, over and over I was told, "No one has ever studied our folk schools who has been able to understand them as Mrs. Campbell has."

Denmark is famous for possessing "the deepest culture of the most widely cultured nation in Europe." Some of us dismiss those achievements with the thought that Denmark's area is small, "only one-third that of North Carolina," and that because of her size and the homogeneity of her people she has been able to accomplish what other countries cannot hope to do. But can one read her history and not thrill to the vision and indomitable courage of a people, politically and economically ruined, who pushed forward "not to political power, not to conquest through war, but to a fuller national development"? "To realize a free and happy nation was the ideal of poet and reformer".

The complete change in the system of agriculture, the reclaimed heathlands, the changes in land tenure, and the extensive system of co-operation are evidences of that great national movement. But in seeking causes, "'t is to the Folkehojskole or folk school, and its children, the Farmers' Agricultural School and the Husmandsskole, that the student, be he economic or social in his approach, must turn finally for an explanation of the Denmark of today."

Unless one digs into the philosophy of Grundtvig, "the priest, poet, historian, and reformer who influenced Danish thought and life more than any other man," he cannot

grasp the real significance of the folk schools. The schools have grown out of his "abiding faith in the soundness of humanity itself" and his belief that "only as the individual becomes fully possessed of the spiritual inheritance of his race does he reach full development." It is only as one reads of his life and his struggles that one understands his revolt against "the dead school" and the learning that was only for a few, and his conviction that all Danish citizens must be educated and "educated without being separated from the work of life."

Mrs. Campbell's chapter on Grundtvig's "Theory of an Education for the People" challenges the reader to much thought. Whatever may be the differences of opinion as to the ages best fitted for going to school, grades and credits as a measure in education, and the use of books in the pursuit of knowledge, there are principles stated over which we shall all do well to ponder. "The first and most important office of a school for the people must be to arouse desire." "The living voice of personality is the medium through which the experiences of life are interpreted to others." "Far better than academic degrees is the understanding which comes from a common experience in toil."

It was Kristen Kold, the son of a poor shoemaker, who really put Grundtvig's theory into practice. That first school, housed in a simple cottage with its eager group of fifteen pupils who gathered for five months of close fellowship with that vivid personality, served as a pattern to other disciples of Grundtvig and more schools were started. As one reads the account of the early history of this movement he is stirred by the zeal and the courage of those who against opposition worked for "an educational ideal at variance with accepted standards of education."

Very vividly does Mrs. Campbell, in her descriptive chapters of the life in the folk schools, bring back to me my visits in Denmark, Norway, Sweden, and Finland. Her clear word pictures, the carefully drawn distinction of the different types of development as seen in the "Husmandsskoles" and the agricultural schools, the adaptations of the Danish theory to different conditions in the other Scandinavian countries—all reveal her careful study and her ability to present sympathetically and convincingly the spirit and essential features of these schools.

In the last chapter Mrs. Campbell faces frankly some of the present day problems in the folk school, the solution of which is baffling the most thoughtful leaders. Must the folk school change to meet new conditions? How far can it "go in the direction of imparting exact information and keep its hold on the heart of Danish life"? Can this type of education hold the industrial worker? And if not, will Denmark be able to "keep her culture and retain her sanity"? But however baffling the problems, the "fine enthusiasm, idealism and understanding" of so many of these teachers will win through. "There is the same power today," one man told me, "but perhaps some new transforming stations are needed." One realizes that "the folk school is a means and not an end. Its value must always be directly proportioned to the quality of those who act as teachers. It stands for a philosophy of life, not primarily a method of teaching." And it is a philosophy we need today in American education.

—Helen H. Dingman

"THE CRUCIBLE"—Burns

If the history of education in the Southern mountains were faithfully written it would be not only a work of intense dramatic interest but a marvelous record of faith and vision, a most significant and triumphant document of human effort in alliance with divine guidance.

Now and then the world hears or reads fragments of this history, now and then catches glimpses of its making: but sadly often does this fragmentary information, seeping through channels of varied motivations, result in a misunderstading of conditions, activities, and objectives. Probably of no section of our country is "so much known that is not true."

Greatly to be welcomed, therefore, is the rare publication which may be rated as dependable and which contributes material of

distinct value to the records of educational development in the mountains of the South.

A volume worthy of such rating has recently been written by James Anderson Burns. The Crucible (Oneida, $2.00) while purporting to be "a tale of the Kentucky feuds" is also the story of the founding and building of Oneida Institute.

The main part of the book is occupied with the beginnings of the school more than a quarter of a century ago. "Burns of the Mountains" is a familiar figure throughout the country by reason of his lectures during the last twelve years given from chautauqua platforms and in educational and religious circles. His great objective in these lectures is to win friends for Oneida and for the mountain children.

The history of its development during the quarter century carries on the remarkable story of its beginnings. "It has grown from the vaguest kind of a vision to an institution with property worth half a million. It has trained hundreds of faithful teachers who have carried the message of peace to thousands of helpless children in the fastnesses of the Cumberlands. . . . I have seen our mountain children emancipated from the bondage of illiteracy and freed from the blight of the feud spirit. . . . We taught the children to love and respect each other, and the feuds died a natural death. Peace can never be secured by drastic laws, battleships, and big guns. But when the children of this world are taught to love each other, then strife and rapine will cease."

—Florence Holmes Ridgeway.

"But . . . . a people politically and economically ruined, is not a people destroyed. Sometimes when one is lowest in the dust, he sees the stars most clearly, and from this time of depression, when it almost seemed as if her pages of history were written, began Danmark's growth to her present condition. She looked backward to what she had been, and forward, not to a political power, not to conquest through war, but to a fuller national life which in its development has had something to teach the great nations."

(*Notes on lecture by Marius Sorenson*)

"Minds are conquered, not by arms, but by greatness of soul."—*Spinoza*.

A FOLK SCHOOL MOTTO

Minds awakened; spirits roused;
Both in beautiful bodies housed.
Masters, we, not slaves, of toil;
Our eyes on the sky; our feet on the soil.